

## ***SMU 56/57 Demonstration Project Air Monitoring***

### ***Appendix D: Completeness***

#### **Project Completeness**

The completeness parameter evaluates the ratio of valid samples collected to scheduled sampling days. The monitoring plan for this project called for collecting a total of 12 sample sets from 21 stations surrounding the remediation site, and from up to 4 sites around the receiving landfill. In addition, the original plan called for 2 duplicate samplers, field blanks and spiked samples.

A number of factors make the completeness determination difficult. The first of these is the equipment and supply problems encountered during the early portions of this project. This led to the establishment of fewer stations than planned, with a total of 20 surrounding the remediation site, and 3 around the landfill.

Two of the remediation zone stations employed the same sampler, with the sampler moved from the initial location (FR09) to the latter (FR14) after the 3<sup>rd</sup> sample run, resulting in a total of 19 sites per sample set. This change was effected to cover a hole in area coverage that was not apparent until a map of the sites was prepared. The station shut down was close enough to another site (FR05) that re-establishment when more equipment became available halfway through the project was considered unnecessary.

The lack of sufficient equipment during the initial stages of the project allowed the establishment of but a single duplicate site (FR01). This was corrected following the 6<sup>th</sup> run when an additional three samplers became available, and a second duplicate station was established (FR03). Although the original plan called for the second duplicate sampler to be shifted between various sites, this proved to be unrealistic.

The remaining two samplers, rather than being deployed within the grid originally planned, were used to establish two distant background stations (FR22 and FR23). The purpose of these sites was to determine more conclusively the effect proximity to the Fox River has on ambient concentrations.

The early portion of the project was also plagued by supply difficulties, especially of the PUF plugs. This problem mostly affected the collection of blank samples, as there were frequently only enough plugs for the required ambient samples. As such, not all sample sets have field blanks directly associated with them, even though more than the originally anticipated number of all blanks were submitted. This is in part due to the establishment of additional types of blank samples (trip and preparation blanks) intended to determine whether the sometimes unusually high sample loading observed during the course of the project was causing cross contamination of samples.

The final complicating factor in determining project completeness is a disabling accident suffered by the primary operator while setting up the 11<sup>th</sup> sample run. This accident, combined with the lateness in the project, prevented the collection of the final intended sample set.

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#### **Ambient Sampling Completeness by Sampling Event**

Completeness criteria for the project are evaluated on several levels: overall (all samples, all sites), per site, per sample event, and quality control samples. The total expected samples values are based on established samplers per sample set for both the design parameter (12 runs during dredging) and the actual runs (11). Sample sets achieving the completeness goal of 75% are regarded as suitable for producing a valid average across the project period.

Deviation from 100% completeness represents sampler failures. The most frequent failures were related to power problems, including but not limited to power cords being unplugged, power not being available at a particular station, and circuit breakers tripping. Other failures were mechanical in nature, including worn out motors and sample timer failures.

Most failed samples that did not collect any volume of air became field blanks, while those that did run for part of the sampling event were discarded. One sample was voided and discarded under the mistaken impression that an insufficient volume had been collected.

Table D-1 below documents the completeness per run for ambient samples. The Pre-Dredge samples represent two sample days at mostly different sites, and are not incorporated into overall completeness values. All runs have a greater than 75% completeness, implying that no particular sampling event is disallowed from further analysis because of failing this criteria. In addition, the overall completeness is greater than 75% for both the Design and Actual determinations. The increase of void samples in November is a result of increasing the sample time from 24 to 72 hours, thereby increasing the likelihood of sampler failure.

**Table D-1: Ambient Sampling Completeness by Sampling Event**

Run	Expected	Ambient	Valid Ambient	Failure Blanks	Void	Completeness
Pre-Dredge	11	11	11	0	0	100.0%
09/22/1999	22	21	19	0	2	86.4%
10/01/1999	22	22	21	0	1	95.5%
10/07/1999	22	21	21	1	0	95.5%
10/13/1999	22	21	20	1	1	90.9%
10/19/1999	22	22	21	0	1	95.5%
10/25/1999	22	21	20	1	1	90.9%
10/31/1999	24	24	23	0	1	95.8%
11/06/1999	24	23	20	1	3	83.3%
11/12/1999	24	23	21	1	2	87.5%
11/18/1999	24	23	21	1	2	87.5%
11/24/1999	24	23	20	1	3	83.3%
11/30/1999	24	0	0	0	0	0.0%
Design	276	244	227	7	18	82.2%
Actual	252	244	227	7	18	90.1%

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#### **Ambient Sampling Completeness by Site**

The determination of completeness by site requires evaluation of the 24 hour and 72 hour portions of the test separately. During the 24 hour sampling, a total of 6 possible samples from each site could be collected. A completeness goal of 4 or more samples (66.7%) is used. A total of 5 sampling periods was possible during the 72 hour sampling, and completeness goal of 3 or more samples (60%) instated. Some sites have not achieved these goals. Averages generated for these sites are somewhat questionable, and are *italicized* in the result tables. Individual results are incorporated into the sampling event evaluations without qualification.

The sites which fail the completeness criteria are FR09 (during 24 hour sampling), FR10 (during 72 hour sampling), and FR14 (during 24 hour sampling). In addition, site FR09 did not exist during the 72 hour sampling, and FR22 and FR23 did not exist during the 24 hour sampling. Causes for the failure in the completeness parameter are documented by site below.

FR09 and FR14 shared the same sampler during the 24 hour sampling period, with 3 runs at the first site and 3 at the second. The final sample collected during this period at FR14 was a sampler failure blank, yielding only 2 ambient samples from this location during the first half of the project.

The sampler at station FR10 developed a faulty timer during the course of the project, which was not clearly diagnosed until setting up the 11<sup>th</sup> sampling event. The accident suffered by the sample operator shortly after this prevented a return to the site to effect repairs, with the result that the site was a single sample short of acceptable completeness.

Several other sites had repeated sampler failures, including all of the sites located within the remediation property, and FR20. Most of the remediation area sampler failures were caused by power problems, most frequently involving the samplers being unplugged by remediation personnel. The sampler at FR20 developed a persistent and difficult to diagnose internal electrical problem.

Table D-2 on the following page documents completeness for each site. The “Samples” column records the total number of all samples collected from each site. The different types of samples includes “Pre” (before dredging commenced), “QC” (duplicates and blanks), “24 Hour” and “72 Hour”. The final two categories represent valid ambient samples collected during each portion of the project.

Completeness values (“Comp” in table D-2 below) are calculated from the ambient samples divided by the potential runs by site. The “Void” column incorporates void samples of all types. The only case where a non-ambient sample is voided is a single duplicate attempt at FR02, when an extra sampler temporarily located at this station failed.

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**Table D-2: Ambient Sampling Completeness by Site**

Site	Samples	QC	Pre	Void	24 Hour	Comp	72 Hour	Comp
FR01	24	14	1	0	4	66.7%	5	100.0%
FR02	13	1	1	2	6	100.0%	3	60.0%
FR03	17	5	1	0	6	100.0%	5	100.0%
FR04	12	2	1	1	4	66.7%	4	80.0%
FR05	11	0	0	2	5	83.3%	4	80.0%
FR06	11	0	0	0	6	100.0%	5	100.0%
FR07	11	0	0	1	6	100.0%	4	80.0%
FR08	12	0	1	2	6	100.0%	3	60.0%
FR09	3	0	0	0	<b>3</b>	<b>50.0%</b>		
FR10	11	3	0	0	6	100.0%	<b>2</b>	<b>40.0%</b>
FR11	11	0	0	0	6	100.0%	5	100.0%
FR12	11	0	0	0	6	100.0%	5	100.0%
FR13	12	0	1	1	5	83.3%	5	100.0%
FR14	8	1	0	0	<b>2</b>	<b>33.3%</b>	5	100.0%
FR16	11	0	0	0	6	100.0%	5	100.0%
FR17	11	0	0	0	6	100.0%	5	100.0%
FR18	11	0	0	1	5	83.3%	5	100.0%
FR19	12	0	1	0	6	100.0%	5	100.0%
FR20	12	0	1	3	4	66.7%	4	80.0%
FR21	14	1	2	0	6	100.0%	5	100.0%
FR22	5	0	0	0			5	100.0%
FR23	5	0	0	2			3	60.0%
LF01	11	0	0	0	6	100.0%	5	100.0%
LF02	11	0	0	1	6	100.0%	4	80.0%
LF03	11	0	0	1	6	100.0%	4	80.0%

### Quality Control Sampling Completeness

Quality control samples incorporated into this project include duplicates, a variety of blanks, and spiked samples. Completeness is evaluated for each of these categories separately. In addition to regular completeness criteria, the percentage of total valid samples represented by each quality control sample category is a valuable tool for determining whether sufficient quality control samples were collected. In general it is desirable for duplicate and blank samples to each comprise between 5 and 10% of the total samples submitted to the lab.

Evaluating duplicate sampling completeness is subject to the same difficulties expressed for the ambient samplers. The original design called for 2 duplicate samples to be collected for each sampling event (a total of 24 potential duplicates), however there was insufficient equipment available to do so until halfway through the project (a total of 17 actual potential duplicates). In addition, three sampler failures yielded one field blank, one void sample and prevented setup of a sample in the third instance.

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Table D-3 below documents duplicate sampling completeness. The sampler failure field blank is not included in the “Samples” column. The Pre-Dredge sample is not included in the completeness evaluation. Spiked samples are evaluated both as duplicates and for the percent PCB recovery. The completeness parameter is evaluated from the Valid duplicates, divided by 24 (Design) or 17 (Actual).

Although the completeness relative to the study design is below the goal of 75%, the value derived from the project as actually run is acceptable. Duplicate samples represent 5.2% of the total samples submitted to the lab.

**Table D-3: Duplicate Sampling Completeness**

<b>Samples</b>	<b>Pre-Dredge</b>	<b>Spikes</b>	<b>Void</b>	<b>Valid</b>	<b>Design</b>	<b>Actual</b>
16	1	2	1	14	58.3%	82.4%

A variety of blank samples were collected during the course of the project: field, lot, trip and preparation blanks. The differences between these are discussed in the Quality Control Sample Results section. The project design specified only the collection of one field blank per sample set, for a total of 12 blanks. Most of the field blanks collected were derived from samplers which failed to turn on, providing a sample which was exposed in the field for the entire time that the ambient samples were.

Completeness for blank samples is evaluated in table D-4 below. It should be noted that this criterion is applied only to the field blanks. All blanks combined represent 10.1% of the ambient samples submitted to the lab. Field blanks have acceptable completeness by both design and actual conditions.

**Table D-4: Blank Sampling Completeness**

<b>Total</b>	<b>Lot</b>	<b>Preparation</b>	<b>Trip</b>	<b>Pre-Dredge</b>	<b>Spiked</b>	<b>Field</b>	<b>Design</b>	<b>Actual</b>
27	3	9	3	1	2	9	75.0%	81.8%

The final category of quality control sample is spiked samples. These samples are submitted in pairs consisting of a “blank” and a “duplicate” each prepared with a known quantity of Aroclor added to the PUF plugs. The “blank” is treated as a field blank and the “duplicate” is used to sample ambient air at a duplicate sampling station. All spiked samples were collected at site FR01.

The project plan called for the collection of at least 2 sets of spiked samples. This goal was achieved, with one set collected during the 24 hour sampling period, and one during the 72 hour sampling period. As such, completeness for the spiked samples is 100%.

Overall, the completeness attained implies that the samples collected provide a generally representative set of data for the evaluation of ambient PCB concentrations during the project. As noted before, some sites have not achieved the required completeness goal. Averages generated for these sites are somewhat questionable, and are *italicized* in the result tables.

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**Analytical Completeness**

The analytical completeness parameter evaluates what percentage of the samples submitted to the laboratory had valid results returned for them. As noted in the Data Validation section, no results from the laboratory have been invalidated because of procedural difficulties or quality control failures. There is no specific quality control limit for this parameter.

A total of 292 ambient samples, duplicates, spikes, blanks and back half samples were submitted to the laboratory for analysis. Results were reported for 290 (99.3%) of these, with 2 ambient samples lost to accidents in the laboratory. In each case, a majority of the samples lost was spilled during extraction, thus preventing subsequent analysis.

While in general a 99.3% analytical return on samples submitted is excellent, loss of ambient samples could be a source of concern by reducing overall completeness. The specific samples lost are from Run 2, site FR21, and Run 4, site FR03. In these cases, resultant completeness values of 90.9% and 86.4% are obtained for the runs, while both sites are reduced to 83.3% during the 24 hour sampling period.